

Q → find  $K_c$ ?



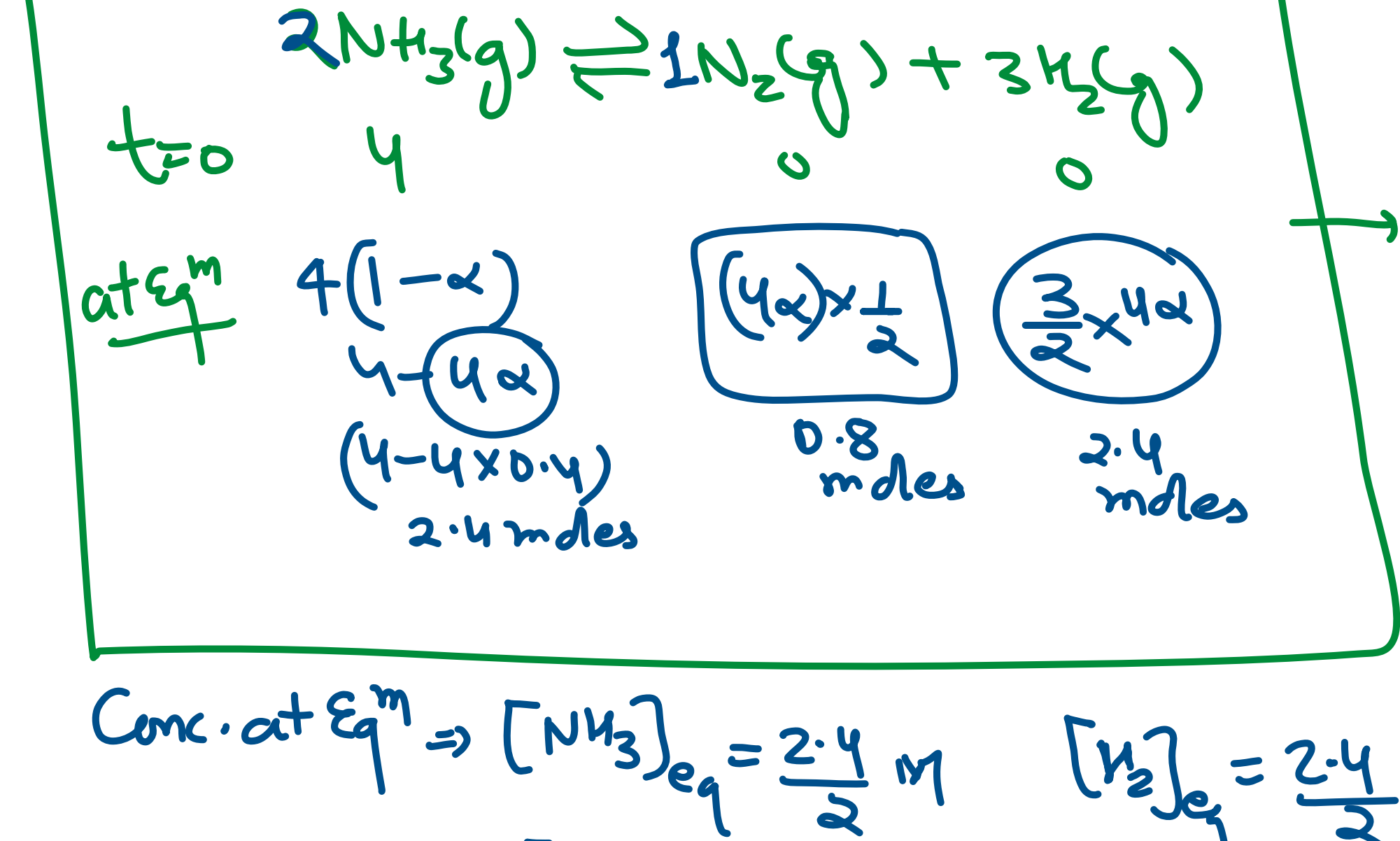
If 40% of  $\text{NH}_3$  dissociates at  $E_q^m$  and 4 moles of  $\text{NH}_3$  added at  $t=0$  in 2L container.

Sol<sup>n</sup>:- Degree of Dissociation of  $\text{NH}_3$  ( $\propto \text{NH}_3$ ) =  $\frac{\% \text{diss}}{100} = \frac{40}{100} = 0.4$

part of 1 mole dissociated

1 → 0.4  
2 →  $2 \times 0.4$   
3 →  $3 \times 0.4$   
4 →  $4 \times 0.4$

moles of  $\text{NH}_3$  dissociated

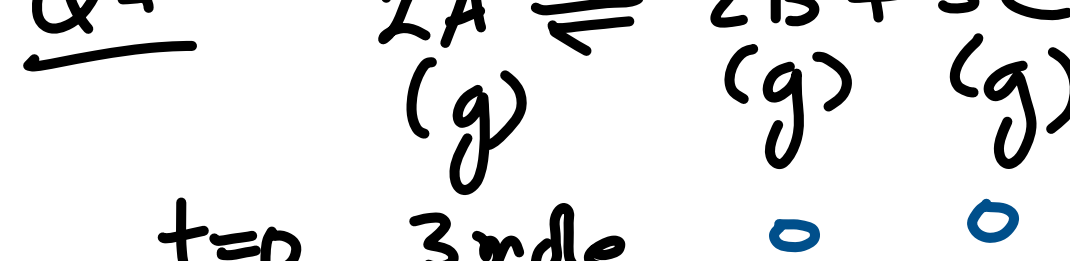


2L cont

$$K_c = \frac{[\text{H}_2]^3 [\text{N}_2]}{[\text{NH}_3]^2}$$

Conc. at  $E_q^m \Rightarrow [\text{NH}_3]_{eq} = \frac{2.4}{2} \text{ M}$   $[\text{H}_2]_{eq} = \frac{2.4}{2}$

$[\text{N}_2]_{eq} = \frac{0.8}{2} \text{ M}$



(g) (g) (g)

$t=0$  3mole 0 0

$\alpha_{\text{A at } E_q^m} = 0.2$  find moles of each species at  $E_q^m$ .



(g) (g) (g)

$t=0$  3mole 0 0

at  $E_q^m$   $3(1-0.2)$  0.6  $(\frac{3}{2} \times 0.6)$

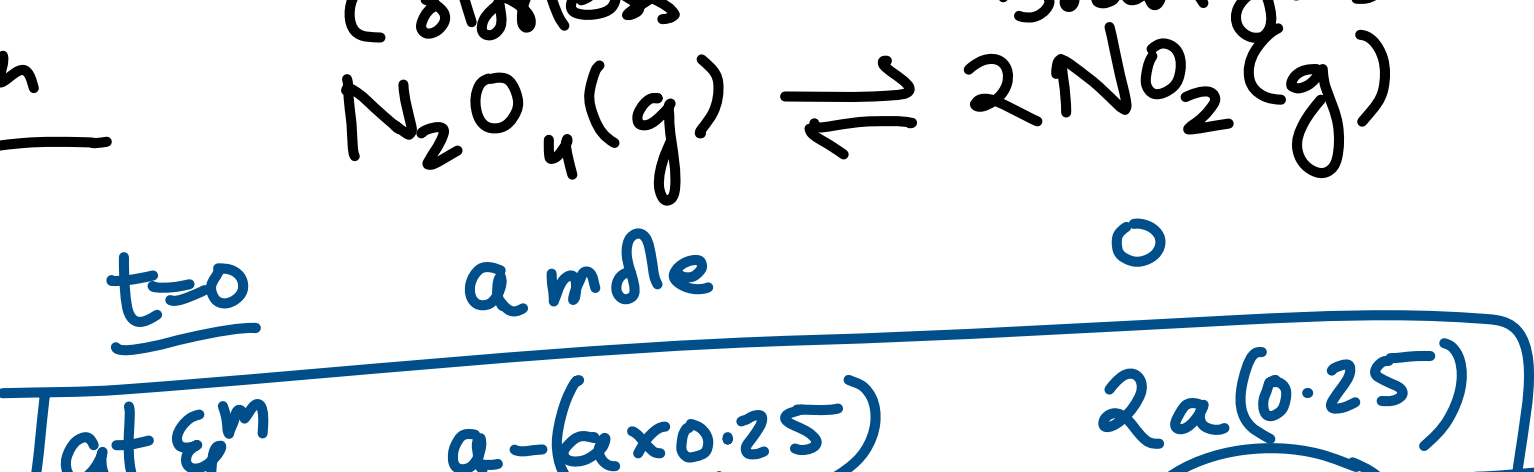
Q →  $\text{N}_2\text{O}_4$  is 25% dissociated at  $37^\circ\text{C}$ , 1 atm.

find  $K_p$

ii) % dissociation of  $\text{N}_2\text{O}_4$  at 0.1 atm &  $37^\circ\text{C}$ .



$t=0$  a mole 0



Total moles at  $E_q^m$

$= 0.75a + 0.5a$

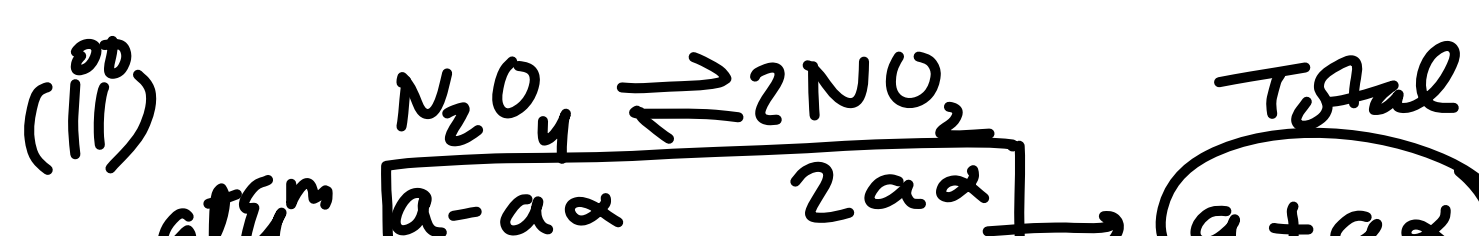
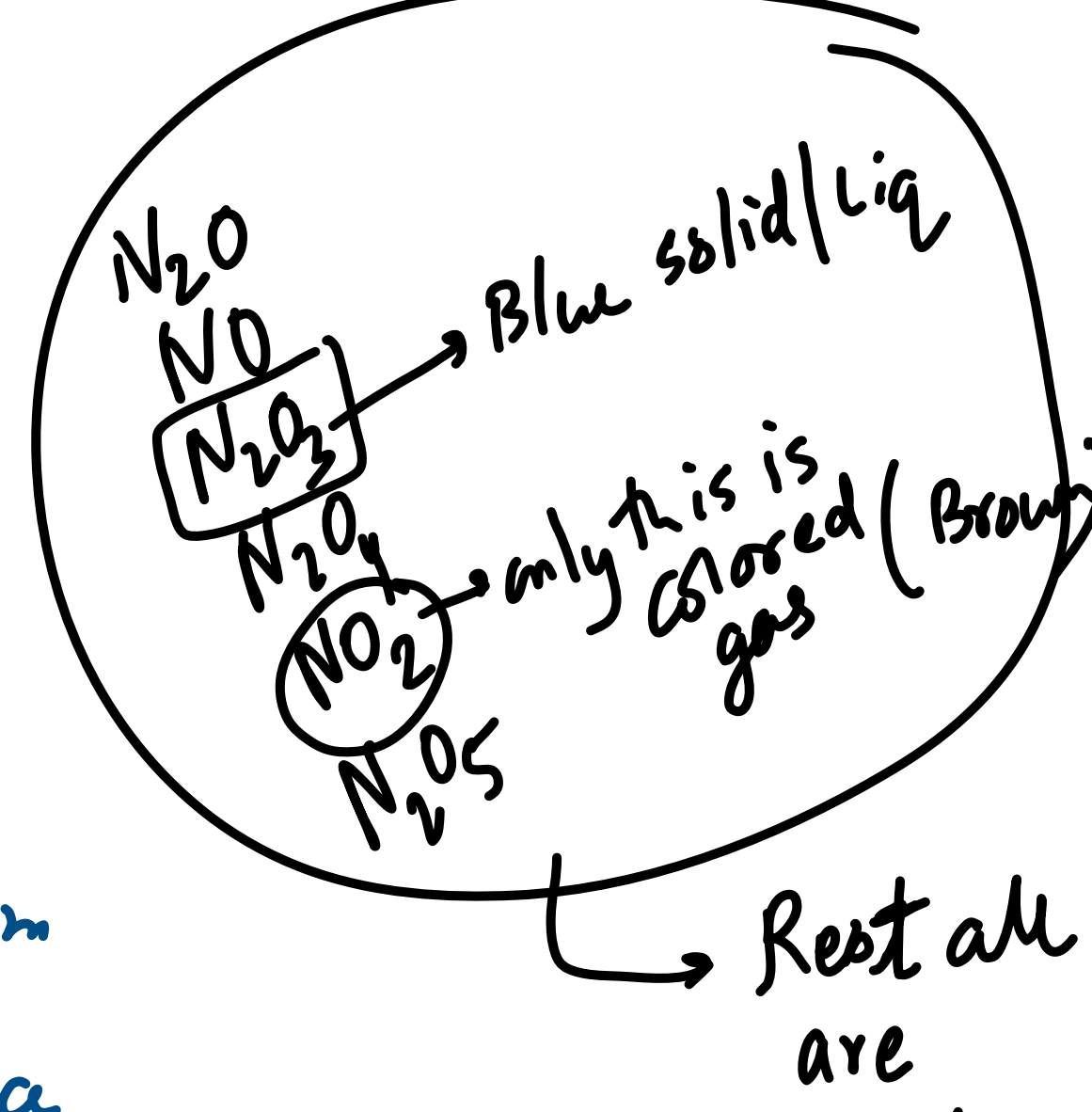
$= 1.25a$

$K_p = \frac{(P_{\text{NO}_2})^2}{P_{\text{N}_2\text{O}_4}} = \frac{(0.5a \times 1)^2}{(1.25a \times 1)}$

$P_{\text{NO}_2} = \chi_{\text{NO}_2} \times P_T \rightarrow 1 \text{ atm}$

$= \frac{0.5a}{1.25a} \times 1$

$K_p = \frac{0.5 \times 0.5}{1.25 \times 1.25} = \frac{0.5 \times 0.5}{1.25 \times 0.75} = \frac{100}{375}$



at  $E_q^m$   $a-a\alpha$   $2a\alpha$  Total

$a+a\alpha$

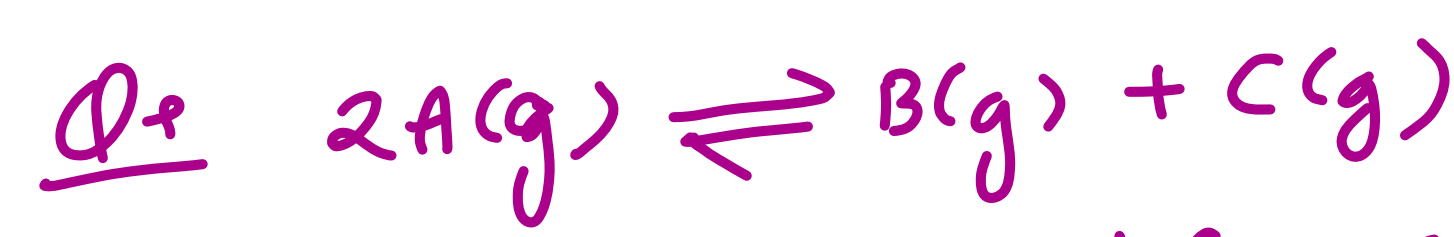
$K_p$  remains same

$K_p = \frac{100}{375} = \frac{(P_{\text{NO}_2})^2}{P_{\text{N}_2\text{O}_4}} = \frac{(\frac{2a\alpha}{a+a\alpha} \times 0.1)^2}{(\frac{a-a\alpha}{a+a\alpha} \times 0.1)}$

$\alpha = \checkmark$

% diss =  $\alpha \times 100$

Ans = 63.24%



at  $E_q^m$ , 500ml of mix of Gas contains 300ml of A+B.

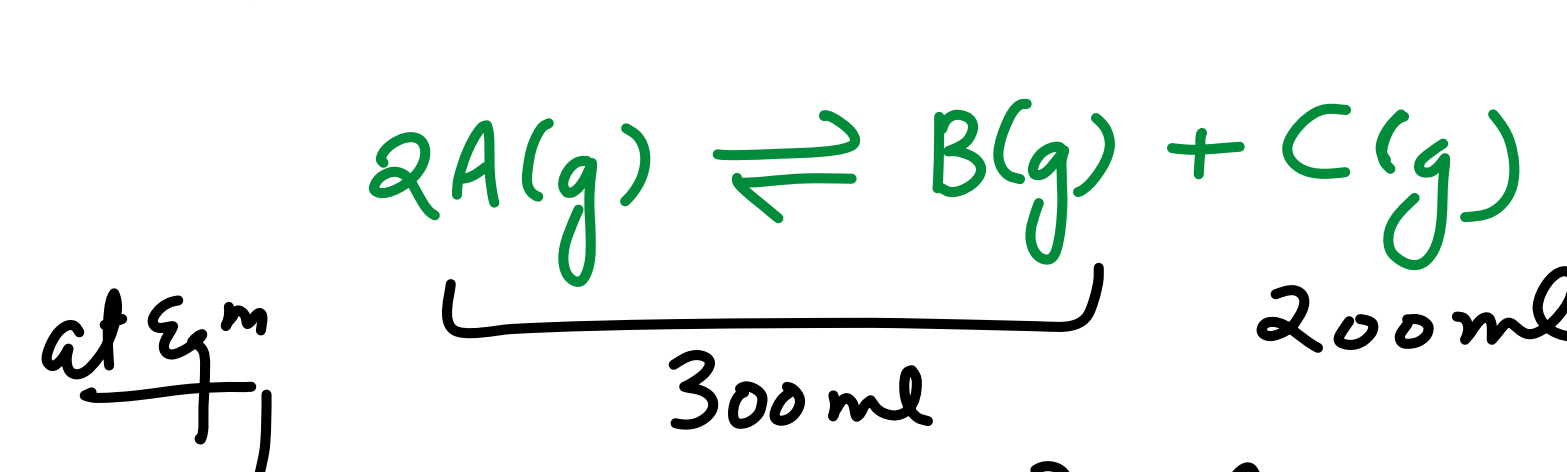
find  $K_p$  at 300K, 1 atm?

Sol<sup>n</sup>:-  $PV = nRT$

$P, T = \text{const}$  → for every Gas

$V \propto n$

for any gas Vol fraction = mole fraction  
Vol % = mole %



Vol. fraction of A =  $\frac{100}{500} = \frac{1}{5} = \chi_A$

$\chi_B = \frac{2}{5} = \chi_C$

$K_p = \frac{P_B \times P_C}{(P_A)^2} = \frac{(\frac{2}{5} \times 10)^2}{(\frac{1}{5} \times 10)^2} = 4$

Relation of Vapour density and Degree of Diss ( $\alpha$ )

$V.D = \frac{\text{Molar mass}}{2}$

$\alpha = \frac{M_T - M_0}{M_0(n-1)}$

$\alpha = \frac{D-d}{d(n-1)}$

$D = \text{V.D of Reactant undergoing Dissociation}$

$= \frac{\text{Molar mass of Reactant}}{2}$

$M_{\text{Theoretical}} \Rightarrow \frac{M_T}{2}$

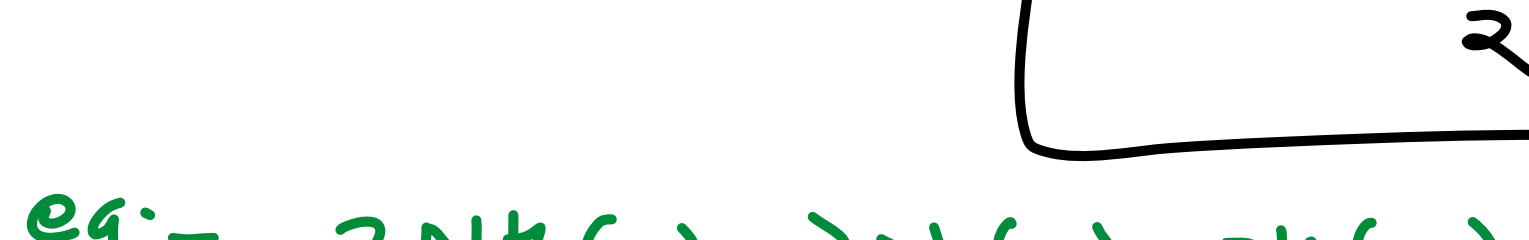
$n \Rightarrow$  no. of products per mole of reactant.

$d = \text{V.D of Gaseous mix at } E_q^m$

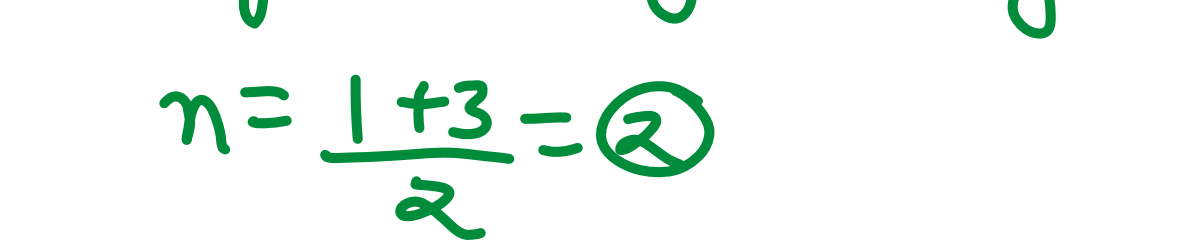
$= \frac{\text{Molar mass of mix}}{2} \text{ or } \frac{M_{\text{average}}}{2}$

$d = \frac{M_{\text{mix}}}{2} \text{ or } \frac{M_{\text{av}}}{2}$

$\frac{M_{\text{observed}}}{2} \text{ or } \frac{M_0}{2}$



$n = \frac{1+3}{2} = 2$



$n = 2$

Q → find % dissociation of  $\text{PCl}_5$  at 300K if

Observed V.d of mix at  $E_q^m$  is 60.



Sol<sup>n</sup>

$\alpha = \frac{(\frac{208.5}{2}) - 60}{60(2-1)} = \frac{104.25 - 60}{60} = 0.7375$

% diss = 73.75%

Note:- V.d of mix & density of mix are different

• If density of mix ( $\rho_{\text{mix}}$ ) at  $E_q^m$  is given, then use following formula

$P M_{\text{mix}} = \rho_{\text{mix}} RT$

$V.d = \frac{M_{\text{mix}}}{2} = \frac{\rho_{\text{mix}} RT}{2P}$

H.W

Solve Example 2 (Pg-129)

V. imp # Concept of Reaction Quotient ( $Q$ )

→ Expression written exactly like  $E_q^m$  const But values of conc. of species are taken at Non- $E_q^m$  point.

⇒ if  $Q < K_{eq}$ ; Forward shift will be there to achieve  $E_q^m$ . [ $R_f > R_b$ ]

⇒ if  $Q > K_{eq}$ ; Backward " " " " " " " [ $R_b > R_f$ ]

⇒ if  $Q = K_{eq}$ ; Rxn is already at  $E_q^m$ . ( $R_f = R_b$ )

Q → If 1mole each of A, B, C, D at added in 2L container, 300K. If

following Rxn takes place:-  $\text{A}(g) + \text{B}(g) \rightleftharpoons \text{C}(g) + \text{D}(g)$

$K_c = \frac{1}{16}$

Find  $E_q^m$  conc. of each species.

Sol<sup>n</sup>:-



$t=0$  1mole 1mole 1mole 1mole

Conc at  $t=0$   $\frac{1}{2} \text{ M}$   $\frac{1}{2} \text{ M}$   $\frac{1}{2} \text{ M}$   $\frac{1}{2} \text{ M}$

$Q_{t=0} = \frac{[D][C]}{[A][B]} = \frac{\frac{1}{2} \times \frac{1}{2}}{\frac{1}{2} \times \frac{1}{2}} = 1 > K_c$

So, ( $R_b > R_f$ ), Backward Shift to achieve  $E_q^m$



at  $E_q^m$   $1-x$   $1-x$   $1-x$   $1-x$

Conc. at  $E_q^m$   $\frac{1+x}{2}$   $\frac{1+x}{2}$   $\frac{1-x}{2}$   $\frac{1-x}{2}$

$K_c = \frac{1}{16} = \frac{(\frac{1-x}{2})^2}{(\frac{1+x}{2})^2}$

$\pm \frac{1}{4} = \frac{1-x}{1+x}$

Solve Pg 128  $Q \rightarrow 125$   
Pg 127,  $Q \rightarrow 109$